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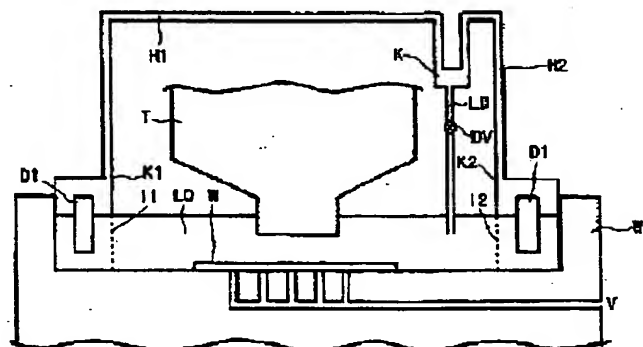
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APPLICANT : NIKON CORP;

INVENTOR : KUDO TAKETO;

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TITLE : ALIGNER, ITS MANUFACTURE,
EXPOSING METHOD AND DEVICE
MANUFACTURING METHOD



ABSTRACT : PROBLEM TO BE SOLVED: To enable continuous correction of imaging performance without vibration, by installing a refractive index adjusting means for adjusting the refractive index of liquid.

SOLUTION: A refractive index adjusting means consists of the following; electrodes D1, ion exchange films 11, 12, bulkheads K1, K2, exhaust pipes H1, H2, a mixer K, an electromagnetic valve DV, an introducing pipe LD, a power source supply part and a second control part. The second control part sends a command to the power source supply part, and applies a specified voltage for a specified period across the two electrodes D1. From one electrode turning to an anode, oxygen gas is generated. From the other electrode turning to a cathode, mixed gas of hydrogen and chlorine is generated. Since the concentration of hydrogen chloride in liquid LQ is decreased, the refractive index of the liquid LQ is decreased. The second control part sends a command to the electromagnetic valve DV, in order to open the valve DV and add high concentration admixture aqueous solution to the liquid LQ. Thereby the refractive index of the liquid LQ is increased.

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..... 製造方法

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**ALIGNER AND ITS MANUFACTURING METHOD
AND EXPOSURE METHOD AND DEVICE
PRODUCTION METHOD**

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H01L 21/027

G03F 7/20 521

[FI]

H01L 21/30 515 D

G03F 7/20 521

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Parties

Applicants

(71) 出願人

識別番号

.....

氏名又 名称

株式会社

住所又 居所

東京都千代田区丸 内 丁目 番 号

(71) [Applicant]

[Identification Number]

000004112

[Name]

NIKON CORPORATION (DB 69-055-0868)

[Address]

Tokyo Chiyoda-ku Marunouchi 3-2-3

Inventors

(72) 発明者

氏名

工藤 威人

住所又 居所

東京都千代田区丸 内 丁目 番 号 株式会
社 内

(72) [Inventor]

[Name]

Kudo **

[Address]

Tokyo Chiyoda-ku Marunouchi 3-2-3 Nikon Corporation (DB
69-055-0868) *

Abstract

(57) 要約

課題

連続的 結像性能 補正 振動 伴
可能 或 投影光学系 開口数
増大及 結像性能 補正 両立

(57) [Abstract]

[Problems to be Solved by the Invention]

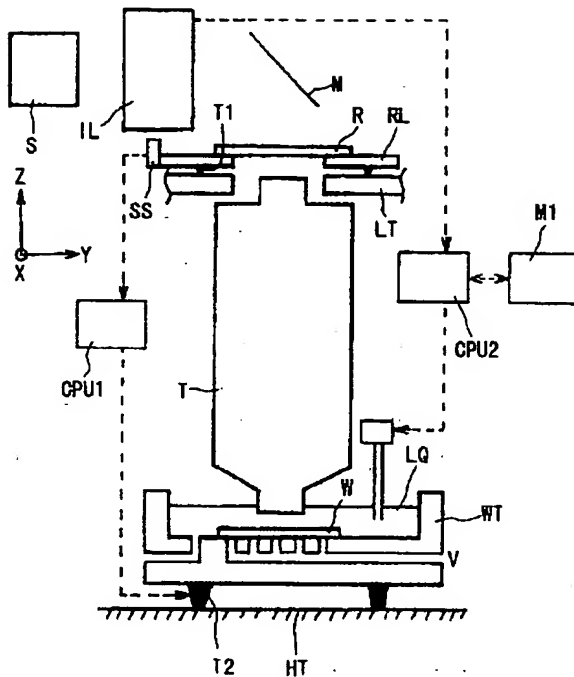
correction of continuous imaging performance is made possible without accompanying the vibration, or both achievements do correction of increase and imaging performance of the number of openings of projection optical system

解決手段

..... R 上 設 照明
照明光学系 IL 像 感光性基
板上 形成 投影光学系 T 有 投影光
学系 感光性基板 間 光路中 少
一部分 位置 液体 LQ 介 露光 行
露光装置 液体 屈折率 調整
屈折率調整手段 有

[Means to Solve the Problems]

It possesses projection optical system.T which forms image of illuminating optical system IL and this pattern which pattern which is provided on reticle R illumination are done on photosensitive group sheet , in light path between projection optical system and photosensitive group sheet atleast through liquid LQ which to position of portion is, with the aligner which exposes, it possesses index of refraction adjustment means in order to adjust index of refraction of liquid .



Claims

特許請求 範囲

請求項 1

..... 上 設 照明 照明光学系 該 像 感光性基板上 形成 投影光学系 有 前記投影光学系 前記感光性基板 間 光路中 少 一部分 位置 液体 介 露光 行 露光装置

前記液体 屈折率 調整 屈折率調整手段 有 特徴 露光装置

請求項 2

前記屈折率調整手段 前記投影光学系 結像性能 補正 前記液体 屈折率 調整 特徴 請求項 1 記載 露光装置

請求項 3

前記投影光学系 結像性能 測定 結像性能測定手段 備

[Claim(s)]

[Claim 1]

In aligner which possesses projection optical system which forms image of the illuminating optical system and said pattern which pattern which is provided on reticle the illumination are done on photosensitive group sheet, in light path between aforementioned projection optical system and aforementioned photosensitive group sheet at least through liquid which toposition of portion is, exposes,

aligner, which possesses index of refraction adjustment means in order toadjust index of refraction of aforementioned liquid and makes feature

[Claim 2]

Aforementioned index of refraction adjustment means, in order correction to do imaging performance of aforementioned projection optics, adjusts index of refractionof aforementioned liquid aligner, which is stated in Claim 1 which is made feature

[Claim 3]

imaging performance measuring means which measures imaging performance of aforementioned projection optical system furthermore having,

前記屈折率調整手段・前記結像性能・補正
 ・前記液体・屈折率・調整
 特徴・請求項 2 記載・露光装置

請求項 4・

前記投影光学系・結像性能・変動・要因・状態・検知・変動要因検知手段・備

前記屈折率調整手段・前記要因・状態・応
 ・前記結像性能・補正・前記液体
 ・屈折率・調整・特徴・請求項 1
 記載・露光装置

請求項 5・

前記照明光学系・前記・対・照明
 条件・変更可能・構成

前記変動要因検知手段・前記照明条件・状態・検知

前記屈折率調整手段・前記照明条件・変更
 ・応・前記結像性能・補正・前記液体・屈折率・調整・特徴・請求
 項 4 記載・露光装置

請求項 6・

前記変動要因検知手段・前記・種類・判別

前記屈折率調整手段・前記・種類・応・前記結像性能・補正・前記液体・屈折率・調整・特徴・請求
 項 4 記載・露光装置

請求項 7・

前記感光性基板・保持・感光性基板・備

該感光性基板・前記投影光学系・
 前記感光性基板・間・光路・前記液体・満
 ・側壁・前記液体・前記感光性基
 板・供給・共・前記感光性基板
 ・回収・供給・回収・
 ・備・特徴・請求項 1 乃至 6
 何・一項記載・露光装置

Aforementioned index of refraction adjustment means , in order correction to do aforesaid imaging performance , adjusts index of refraction of the aforesaid liquid aligner . which is stated in Claim 2 which is made feature

[Claim 4]

Fluctuation factor detection means which detects state of factor offluctuation of imaging performance of aforesaid projection optical system furthermore having,

Aforementioned index of refraction adjustment means in order correction to do aforesaid imaging performance according to state of aforesaid factor , adjusts index of refraction of aforesaid liquid the aligner . which is stated in Claim 1 which is made feature

[Claim 5]

Aforementioned illuminating optical system configuration is done illumination condition for the aforesaid reticle in changeable ,

Aforementioned fluctuation factor detection means detects state of the aforesaid illumination condition ,

Aforementioned index of refraction adjustment means in order correction to do aforesaid imaging performance according to modification of the aforesaid illumination condition , adjusts index of refraction of the aforesaid liquid aligner . which is stated in Claim 4 which is made feature

[Claim 6]

As for aforesaid fluctuation factor detection means , being something which distinguishes types of aforesaid reticle ,

Aforementioned index of refraction adjustment means in order correction to do aforesaid imaging performance according to types of aforesaid reticle , adjusts index of refraction of aforesaid liquid the aligner . which is stated in Claim 4 which is made feature

[Claim 7]

photosensitive group sheet holder which keeps aforesaid photosensitive group sheet furthermore having,

Either of Claims 1 through 6 to which said photosensitive group sheet holder , as aforesaid projection optical system and sidewall and aforesaid liquid in order to fill up the light path between aforesaid photosensitive group sheet with aforesaid liquid are supplied to aforesaid photosensitive group sheet holder , has supply & recovery unit in order to recover from aforesaid photosensitive group sheet holder and makes feature aligner .

which is stated in one section

[Claim 8]

As for aforementioned index of refraction adjustment means ,
from additive supply unit and aforementioned liquid which
supply additive in order to adjust index of refraction ,
aforementioned liquid aforementioned additive either of
Claim 1 to 7 which possesses additive recovery unit in order to
recover and makes feature aligner . which is stated in
one section

[Claim 9]

In origin of predetermined illumination condition pattern which is provided on step. aforementioned reticle which reticle illumination is done including the step which copies to photosensitive group sheet making use of projection optical system , in exposure method which through predetermined liquid , leads light from aforementioned projection optical system to aforementioned photosensitive group sheet .

exposure method , which includes step which adjusts index ofrefraction of aforementioned liquid in order correction to do the imaging performance of aforementioned projection optical system , and makes feature

[Claim 10]

In origin of predetermined illumination condition device pattern which is provided on step. aforementioned reticle which reticle illumination-is done including the step which is copied to photosensitive group sheet making use of projection optical system , light from aforementioned projection optical system through predetermined liquid , regarding to device production method which it leads to aforementioned photosensitive group sheet .

When aforementioned reticle and inside at least one of the aforementioned illumination condition is modified, index of refraction of the aforementioned liquid is modified, device production method, which is made a feature

[Claim 11]

In manufacturing method of aligner which possesses projection optical system which forms the image of illuminating optical system and said pattern which pattern which is provided on reticle illumination are done on photosensitive group sheet, in light path between the aforementioned projection optical system and aforementioned photosensitive group sheet at least through the liquid which to position of portion is, exposes,

step. which measures imaging performance of aforementioned projection optical system

manufacturing method . of aligner which includes step which decides the initial value of index of refraction of

特徴・・・露光装置・製造方法・

Specification

・発明・詳細・説明・

0001・

・発明・属・技術分野・

本発明・・・・・・上・設・・・・・・
 ・・・・・・・感光性基板上・投影・・・・投影光学
 系・備・・・・露光装置及・該露光装置・用・・・・
 露光方法並・・・・・・製造方法・関・・・・

・・・・詳・・・・本発明・投影光学系・感光性
 基板・間・光路・液体・充填・・・・液浸型露
 光装置・関・・・・

本発明・半導体素子・撮像素子(CCD等)・液
 晶表示素子・・・・薄膜磁気・・・・等・製造・
 ・際・好適・・・・・・

0002・

・従来・技術・

光学系・最終面・像面・間・空間・・・・
 ・・・・・・・言・・・・従来・露光装置・投
 影光学系・・・・・・空間・
 満・・・・・・

・・・・IC・LSI・製造・過程・於・・・・
 ・工・・・・露光・・・・・・微細化
 ・常・望・・・・・・露光・用・
 ・光・波長・短・・・・・・像側・開口
 数・大・・・・必要・・・・

光・波長・短・・・・・・満足・・・・結像性
 能・得・・・・露光・満足・光量・確保・・・・
 ・透過率・持・・・・材料・少・・・・

0003・

・・・・像面・・・・最終媒質・・・・空気・・・・屈折率
 ・大・・・・液体・・・・・・像側・開口数・大
 ・・・・・・・提案・・・・・・液体
 ・用・・・・投影光学系・持・露光装置・液浸
 型露光装置・呼・・・・・・

・・・・露光装置・・・・・・投影光学系・結像
 性能・補正・・・・・・投影光学系・最・物体
 側・光路或・・・・最・像側・光路中・・・・結像性
 能・調整・・・・・・結像性能補正部材・交換
 可能・設・・・・技術・知・・・・

aforementioned liquid and said on basis of imaging performance which was measured, makes feature

[Description of the Invention]

[0001]

[Technological Field of Invention]

As for this invention, device pattern being provided on reticle it regards the exposure method and device production method which use aligner and said aligner which have the projection optical system which projection is done on photosensitive group sheet.

Furthermore as for details, as for this invention liquid it regards the liquid dampen type aligner which is filled in light path between projection optical system and photosensitive group sheet.

this invention, when semiconductor element, image pickup element (CCD array etc), producing liquid crystal display element, or thin film magnetic head etc, is preferred ones.

[0002]

[Prior Art]

^{working distance}
 [waakingudisutansu] With it is final aspect of optical system and space between the image plane, but with projection optical system of conventional aligner as for [waakingudisutansu] it was filled upwith air.

By way, regarding to process which produces IC and LSI, pattern which it exposes to silicon wafer, narrowing being always desired, forthat makes light wavelength which is used for exposure short, or is necessaryto enlarge number of openings of image side.

As light wavelength becomes short, while obtaining imaging performance which it can besatisfied glass material which has sufficient transmittance which can guarantee satisfactory light intensity in exposure decreases.

[0003]

final medium to image plane, number of openings of image side is enlarged by thefact that index of refraction it is larger than air, makes the liquid being proposed, that way aligner which has projection optical system which uses liquid is called liquid dampen type aligner then.

Well, in order correction to do imaging performance of projection optical system, most light path of object side of projection optical system or most technology which provides imaging performance corrected part material in order to adjust imaging performance in light path of image side, in exchangeable has been known regarding aligner.

0004

發明・解決・・・・・・課題・

・・・・・・液浸型露光裝置・・・・・・投影光学系・感光性基板・・・・・・間・光路(・・・・・・)・液体・満・・・・・・構成・・・・・・結像性能・補正・・・・・・部材・配置・・・・・・困難・・・・・・

・・・・・・結像性能補正部材・・・・・・有限・数・現実的・裝置・構成・考・・・・・・数個程度・準備・・・・・・離散的・・・・・・結像性能・補正・・・・・・問題点・・・・・・

0005

・・・・・・投影光学系・結像性能・所定・許容範圍・収・・・・・・必要・・・・・・上述・・・・・・結像性能・補正・離散的・・・・・・所定・許容範圍内・収・・・・・・困難・・・・・・

特・露光・・・・・・微細化・露光面積・増大・求・・・・・・結像性能・許容範圍・狭・・・・・・感光性基板・・・・・・走査・・・・・・露光・行・走査露光方法・行・場合・結像性能特性・變動幅・許容範圍・狭・・・・・・離散的・補正・・・・・・対応・・・・・・

0006

・・・・・・上述・・・・・・結像性能補正部材・交換時・・・・・・投影光学系自体・振動・発生・・・・・・結像性能・悪影響・生・・・・・・恐・・・・・・

・・・・・・本發明・連續的・結像性能・補正・振動・伴・・・・・・可能・・・・・・第1・目的・・・・・・

・・・・・・本發明・投影光学系・開口数・増大・結像性能・補正・・・・・・両立・第2・目的・・・・・・

0007

課題・解決・・・・・・手段・

上述・第1・目的・達成・・・・・・本發明・露光裝置・・・・・・上・設・・・・・・照明・照明光学系・・・・・・像・感光性基板上・形成・・・・・・投影光学系・有・・・・・・投影光学系・感光性基板・・・・・・間・光路中・少・・・・・・一部分・位置・・・・・・液体・介・・・・・・露光・行・露光裝置・・・・・・液体・屈折率・調

[0004]

[Problems to be Solved by the Invention]

But, with liquid dampen type aligner, because it is a configuration which fills up liquid in light path ([waakingudisutansu]) between projection optical system and photosensitive group sheet, member in order correction to do imaging performance is arranged is difficult.

In addition, because when quantity of finite, of configuration of the actual device is thought, only several extent prepares this kind of imaging performance corrected part material and, is possible, in only discrete imaging performance there is a problem which correction it is not possible.

[0005]

In addition, imaging performance of projection optical system it is necessary to store to the predetermined tolerance, but above-mentioned way if correction of imaging performance is possible to only discrete, you supply inside this predetermined tolerance, it becomes difficult.

Especially, when it can seek narrowing of exposure pattern and increase of exposed surface area, tolerance of this imaging performance becomes narrow, in addition, while scan doing reticle and photosensitive group sheet, when it does scanning light exposure method which exposes, tolerance of variation of imaging performance characteristic has become narrow, with dispersive correction cannot correspond.

[0006]

In addition, because vibration of projection optical system itself occurs in when exchanging imaging performance corrected part material an above-mentioned way, there is also a possibility adverse effect occurring to imaging performance.

Then, this invention makes correction of continuous imaging performance possible without accompanying vibration, it makes first objective.

In addition, this invention designates both achievements of thing which increase and imaging performance of number of openings of projection optical system correction is done as second objective.

[0007]

[Means to Solve the Problems]

In order to achieving above-mentioned first objective, with this invention as for aligner, with aligner which possesses projection optical system which forms the image of illuminating optical system and this pattern which pattern which is provided on reticle illumination are done on photosensitive group sheet, in light path between the projection optical system and photosensitive group sheet at

整 屈折率調整手段 . 有

0008 .

. 上記請求項 2 . 掲 . . . 好 . . . 態様 .
 屈折率調整手段 . 前記投影光学系
 . 結像性能 . 補正 液体 . 屈折率 .
 調整

. . 構成 . 基 請求項 3 . 掲 . . 好 . . .
 . 態様 投影光学系 . 結像性能 . 測
 定 . . 結像性能測定手段 備
 . . 屈折率調整手段 . 前記結像性能 . 補正
 液体 . 屈折率 . 調整

0009 .

. . . 請求項 4 . 掲 . . 好 . . . 態様 . . .
 . . 投影光学系 . 結像性能 . 変動 . 要因 . 状態
 検知 . . 変動要因検知手段 備 . . .
 屈折率調整手段 . 要因 . 状態 .
 応 . . 結像性能 . 補正 液体 . 屈折
 率 . 調整

. . 構成 . 基 請求項 5 . 掲 . . 好 . . .
 . 態様 照明光学系 . 前記
 . 対 . . 照明条件 . 変更可能 . 構成 . . . 変動
 要因検知手段 . 照明条件 . 状態 . 検知 . 屈
 折率調整手段 . 照明条件 . 変更 . 応 . . 結
 像性能 . 補正 液体 . 屈折率 . 調整 .

0010 .

. . . . 請求項 6 . 掲 . . 好 . . . 態様 . . .
 . . 変動要因検知手段 種類 . 判
 別 屈折率調整手段
 . . 種類 . 応 . . 結像性能 . 補正
 液体 . 屈折率 . 調整

. . . 上述 . 第 2 . 目的 . 達成
 投影光学系 . 感光性基板 . . 間 . 光路 . 全 .
 . 液体 . 満 好

. 本発明 . . . 露光装置 . . 投影光学
 系 . 感光性基板 . . 間 . 光路 . 前記液体 . 満
 側壁 . 液体 . 前記感光性基板 . .

least through liquid which to position of portion is, exposes. It
 is something which possesses index of refraction adjustment
 means in order to adjust index of refraction of liquid.

[0008]

If according to desirable embodiment where here, it put out in the above-mentioned Claim 2, index of refraction adjustment means, in order the correction to do imaging performance of aforementioned projection optical system, is something which adjusts index of refraction of liquid.

On basis of this configuration, if according to desirable embodiment where it put out in Claim 3, being something which furthermore has the imaging performance measuring means which measures imaging performance of projection optical system, index of refraction adjustment means, in order correction to do aforementioned imaging performance, is something which adjusts index of refraction of liquid.

[0009]

In addition, if according to desirable embodiment where it put out in Claim 4, being something which furthermore has fluctuation factor detection means which detects state of factor of fluctuation of imaging performance of projection optical system, index of refraction adjustment means in order correction to do the imaging performance according to state of factor, is something which adjusts index of refraction of liquid.

On basis of this configuration, if according to desirable embodiment where it put out in Claim 5, illuminating optical system configuration is done illumination condition for the aforementioned reticle in changeable, fluctuation factor detection means detects the state of illumination condition, index of refraction adjustment means in order correction to do imaging performance according to modification of illumination condition, is something which adjusts index of refraction of liquid.

[0010]

If according to desirable embodiment where and, it put out in the Claim 6, as for fluctuation factor detection means, being something which distinguishes types of reticle, as for index of refraction adjustment means, in order correction to do imaging performance according to types of reticle, it is something which adjusts index of refraction of liquid.

In addition, in order to achieve above-mentioned second objective, all of light path between projection optical system and photosensitive group sheet is filled up with the liquid, it is desirable.

This time, aligner as sidewall and liquid in order to fill up light path between projection optical system and photosensitive group sheet with aforementioned liquid are

・ ・ ・ 供給 ・ ・ ・ 共 ・ 前記感光性基板 ・ ・ ・
 ・ ・ ・ 回収 ・ ・ ・ ・ 供給 回収 ・ ・ ・ ・ ・ 備
 ・ 感光性基板 ・ 保持 ・ 感光性基板 ・ ・ ・
 ・ ・ ・ ・ 有 ・ ・ ・ ・ ・ 好 ・ ・ ・ ・

0011 ・

・ ・ 屈折率調整手段 ・ ・ 液体 ・ 屈折率 ・ 調整
 ・ ・ ・ ・ 添加剤 ・ 供給 ・ ・ 添加剤供給 ・ ・
 ・ ・ ・ 液体 ・ ・ 前記添加剤 ・ 回収 ・ ・ ・ ・
 添加剤回収 ・ ・ ・ ・ ・ 有 ・ ・ ・ ・ ・ 好 ・ ・ ・ ・

0012 ・

・ 発明 ・ 実施 ・ 形態 ・

上述 ・ 構成 ・ ・ ・ ・ 本発明 ・ ・ ・ ・ ・ 投影光
 学系 ・ 感光性基板 ・ ・ ・ 間 ・ 光路中 ・ 位置 ・ ・
 液体 ・ 屈折率 ・ 調整 ・ ・ ・ ・ ・ 混合液体
 ・ 屈折率 ・ 変化 ・ ・ ・ 投影光学系 ・ 結像性能
 ・ 補正 ・ ・ ・ ・ ・

・ ・ ・ 屈折率調整 ・ 手法 ・ ・ ・ ・ 液体 ・ 多
 物質 ・ 混合液体 ・ ・ ・ ・ ・ 混合液体
 ・ 屈折率 n ・ ・ ・ ・ ・
 (Lorentz-Lorenz) ・ 式 ・ 従 ・ ・

0013 ・

数 1 ・

$$\left(\frac{n^2 - 1}{n^2 + 2} \right) = \sum_{i=1,2,\dots} m_{(i)} \times \left(\frac{n_{(i)}^2 - 1}{n_{(i)}^2 + 2} \right) \times \frac{\rho}{\rho_{(i)}}$$

0014 ・

・ ・ ・ ・

但 ・ ・

0015 ・

数 2 ・

$n_{(i)}$: i 番目の物質の屈折率、
 $m_{(i)}$: i 番目の物質の重量分率、
 $\rho_{(i)}$: i 番目の物質の密度、

0016 ・

supplied to aforementioned photosensitive group sheet holder has supply & recovery unit in order to recover from aforementioned photosensitive group sheet holder with this invention, furthermore possesses photosensitive group sheet holder which keeps photosensitive group sheet, it is desirable.

[0011]

In addition, index of refraction adjustment means, aforementioned additive has additive recovery unit in order to recover from additive supply unit and liquid which supply additive in order to adjust index of refraction liquid, it is desirable.

[0012]

[Embodiment of the Invention]

Regarding to above-mentioned configuration or other this invention, because you can adjust the index of refraction of liquid which position in light path between projection optical system and photosensitive group sheet is, correction is possible imaging performance of the projection optical system with change of this index of refraction.

When we assume, that here, liquid is mixed solution of multi substance as technique of index of refraction adjustment, as for index of refraction n of this mixed solution, in formula of Lorentz * Lawrence (Loren tz-Loren z) following,

[0013]

[Mathematical Formula 1]

[0014]

With it becomes.

However,

[0015]

[Mathematical Formula 2]

[0016]

.....

例・液体・水溶液・水溶液・屈折率・水溶液自体・濃度・応・変化・水溶液・添加・物質・濃度・増減・良

.....投影光学系・結像性能・補償・屈折率・値・液体・屈折率・変化・投影光学系・結像性能・良好・

0017・

.....屈折率・調整・例・投影光学系・収差・結像性能・測定・結果・屈折率・調整・良・投影光学系・結像性能・變動・対応・要因・變動・検知・結果・屈折率・調整・良

前者・投影光学系・結像性能・測定・手法・露光装置・製造時・投影光学系・収差・測定・収差・補償・屈折率・値・液体・屈折率・初期値・設定・良

.....製造時・調整・一部・屈折率・調整・製造・調整・容易・利点

.....露光装置自体・収差測定機構・設・収差測定機構・収差測定結果・液体・屈折率・変更・良

0018・

一方・後者・結像性能・變動・対応・要因・變動・種類・照明条件・状態・投影光学系・通過・露光工・量・挙

.....照明・際・照明条件(σ値・変形照明・否・)・上・設・種類・最適・決・照明条件・変・投影光学系・収差・初・結像性能・変化

.....例・種類・照明条件・要因・要因・變動・伴・変化・結像性能・補償・屈折率・値・予・記憶・要因・変

So it is.

When for example liquid is designated as aqueous solution, in order index of refraction of this aqueous solution to change according to density of the aqueous solution itself, if it increases and decreases density of substance which is added to aqueous solution, it is good.

Because of this, in order to reach value of index of refraction which compensation it is possible imaging performance of projection optics, if index of refraction of liquid it changes, imaging performance of projection optical system becomes satisfactory ones.

[0017]

Here, adjustment of index of refraction measures aberration or other imaging performance of the for example projection optical system, is good adjusting index of refraction as a result according to, detecting fluctuation of factor which corresponds to the fluctuation of imaging performance of projection optical system, as a result according to adjusting index of refraction is good.

It measures aberration etc of projection optical system when producing aligner regarding technique which measures imaging performance of projection optical system of the former, it is good setting value of index of refraction which this aberration compensation is done to initial value of index of refraction of the liquid.

This way if index of refraction is adjusted as portion of adjustment when producing, production * there is a benefit where adjustment becomes easy.

In addition, it provides aberration instrument structure etc in aligner itself, it is good modifying index of refraction of liquid with this aberration instrument structure according to aberration measurement result.

[0018]

On one hand, you can list exposure dose etc which passes state, projection optical system of the types, illumination condition of reticle as fluctuation of factor which corresponds to fluctuation of imaging performance of the latter.

When here, illumination doing reticle, as for illumination condition (σ value, such as deformation illumination whether or not), when optimum ones are decided with types of pattern which is provided on the reticle, this illumination condition changes, imaging performance which begins aberration of the projection optical system changes.

Then, in every types, illumination condition or other factor of for example reticle, it is worthy of index of refraction in order compensation to do imaging performance which changes attendant upon fluctuation of this factor storage, detects

動・検知・記憶・・・関係・基・・・液体・屈折率・調整・・・良・・・

・・・投影光学系・通過・・・露光工・・・量・大小・・・投影光学系・結像性能・変化・・・照射変動・・・場合・・・露光工・・・量・・・露光工・・・量・大小・・・変化・・・結像性能・補償・・・屈折率・値・予・・・記憶・・・要因・変動・検知・記憶・・・関係・基・・・液体・屈折率・調整・・・良・・・

・・・手法・・・記憶・・・代・・・所定・計算式・算出・・・良・・・

0019・

・・・液体・屈折率・調整・・・投影光学系・結像性能・・・特・球面収差・像面湾曲・補正・効果の・・・

以下・図面・参照・・・本発明・・・実施・形態・・・説明・・・

[第1・実施・形態]図1・・・本発明・・・第1・実施・形態・・・露光装置・概略的・示・図・・・

尚・図1・・・XYZ座標系・採用・・・

0020・

図1・・・光源S・・・例・・・波長248nm・露光光・供給・・・光源S・・・露光光・照明光学系IL及・反射鏡M・介・・・R・・・均一・照度分布・・・照明・・・

・・・本例・・・光源S・・・KrF工・・・光源・用・・・代・・・193nm・露光光・供給・・・ArF工・光源・g線・i線等・供給・・・高圧水銀・・・等・用・・・良・・・

・・・図1・・・不図示・・・照明光学系IL・面光源・形成・・・面光源・・・光・集光・・・被照射面・重畳的・均一・照明・・・光学系・・・形成・・・面光源・位置・配置・・・面光源・形状・可変・・・可変開口絞・・・有・・・

fluctuation of this factor beforehand in memory and etc if it adjusts index of refraction of liquid on basis of relationship which is remembered, it is good.

In addition, imaging performance of projection optical system changes with size of exposure dose which passes projection optical system, there is so-called lighting fluctuation, but in this case putting, storage, detects fluctuation of this factor beforehand in exposure dose and it is worthy of index of refraction in order compensation to do imaging performance which changes at size of this exposure dose memory etc, If index of refraction of liquid is adjusted on basis of the relationship which is remembered, it is good.

Furthermore, to memory it is good instead of storage doing, calculating with predetermined computational formula in this technique.

[0019]

This way, by fact that index of refraction of liquid is adjusted, among imaging performance of projection optical system, it is effective in correction of especially spherical aberration, image plane curvature.

Below, referring to drawing, you explain concerning embodiment which depends on this invention.

[first embodiment] Figure 1 is figure which with first embodiment which depends on the this invention shows aligner in conceptual.

Furthermore with Figure 1, XYZ coordinate system is adopted.

[0020]

In Figure 1, light source S supplies exposure light of for example wavelength 248nm, exposure light from this light source S, through illuminating optical system IL and reflector M, almost illumination does reticle R in origin of uniform illumination distribution.

Here, with this example KrF excimer laser light source is used as light source S, but in place of that, making use of high pressure mercury lamp etc which supplies ArF excimer laser light source and the g-line, i-line etc which supply exposure light of 193 nm it is good.

In addition, with Figure 1 it is not shown in the diagram, but illuminating optical system IL light collection doing optical integrator in order to form planar light source, and light from this planar light source being arranged in location of planar light source which is formed by the capacitor optical system and optical integrator in order uniform illumination to do irradiated surface superimposition is something which possesses variable aperture drawing in order to designate shape of planar light source as variable.

面光源・形状・光軸・偏心・
複數・面光源・持・輪帶形状・
円形状・大・

照明光学系 IL 例 米国
特許第 5,329,094 号公報 米国特許第
5,576,801 号公報 開示 用

0021

R 通過 回折 露光光
投影光学系 T 経 工 W 上 達 工
上 R 像 形成

R RL
保持 RL 任意 時
LT 上 駆動装置 T1
X 軸及 Y 軸上 任意 速度 移動
構成

RL
LT 上 移動速度 速度 SS 検
知 速度 SS 出力 第
1 制御部 CPU1 伝達

0022

工 W 工 WT
保持

工 WT 液体 LQ 溜
側壁 設

本例 側壁 工 W 投影
光学系 T 光路 全 液体 LQ 満
構成

工 WT 駆動装置 T2
HT 上 X 軸方向及 Y 軸
方向 任意 速度 移動 構成

0023

上記 第 1 制御部 CPU1
RL LT 上 移動
速度 投影光学系 T 露光倍率 β 工
WT 上 移動
速度 算出 駆動装置 T2 伝達

駆動装置 第 1 制御部 CPU1 伝達
移動速度 基 工 WT 移
動

0024

図 2 工 WT 構成 詳細
表 図

Here, as shape of planar light source, from optical axis eccentricity those which have planar light source of plural which is done. Those of wheel band shape. There are some etc where size differs in circular.

As this kind of illuminating optical system IL, those which are disclosed in for example U. S. Patent No. 5,329,094 disclosure and the U. S. Patent No. 5,576,801 disclosure can be used.

[0021]

And, exposure light which reticle R passing *diffraction is done, passing by projection optical system T, reaches on wafer W, image of reticle R is formed on wafer.

Here, reticle R is kept with [rechikururoodaa] RL, [rechikururoodaa] RL is done in order at time of option on [roodaateeburu] LT on "X" axis and the "Y" axis to be able to move with velocity of option due to the drive device T1, configuration.

Here, mobility on [roodaateeburu] LT of [rechikururoodaa] RL is detected with the velocity sensor SS, output from this velocity sensor SS is transmitted to 1st controller CPU 1.

[0022]

In addition, wafer W is kept by wafer table WT.

reservoir *sidewall of for sake of has been provided liquid LQ in this wafer table WT.

With this example, it has become configuration where from wafer W all of light path to projection optical system T is filled up with liquid LQ by this sidewall.

This wafer table WT is done in order on holder table HT to be able to move to "X" axis direction and "Y" axis direction with velocity of option due to the drive device T2, configuration.

[0023]

Here, above-mentioned 1st controller CPU 1, calculates mobility on holder table of wafer table WT from mobility on [roodaateeburu] LT of [rechikururoodaa] RL, and the exposure draw ratio; be of projection optical system T transmits to drive device T2.

drive device moves wafer table WT on basis of mobility which was transmitted from 1st controller CPU 1.

[0024]

Figure 2 is figure which displays configuration of this wafer table WT in detail.

・ 図 2 ・ ・ ・ ・ ・ 投影光学系 T ・ 最 ・ ・ ・ 工
W 側 ・ 光学部材 ・ ・ 投影光学系 T ・ 金枠 ・ ・
間 ・ ・ 液体 LQ ・ 浸透 ・ ・ ・ ・ ・ 密着 ・ ・
・ ・ ・ ・ ・

・ ・ ・ ・ 工 ・ ・ ・ ・ WT ・ 底部 ・ ・ ・ 複数 ・
開口 ・ 設 ・ ・ ・ ・ ・ 開口 ・ 接続 ・
・ ・ ・ 配管 V ・ ・ 減圧 ・ ・ ・ ・ ・ 工 ・
W ・ ・ 工 ・ ・ ・ ・ WT ・ 吸着 ・ ・ ・ ・

・ ・ ・ ・ 工 ・ ・ ・ ・ WT ・ ・ ・ 電極 D1,D2
・ 設 ・ ・ ・ ・ ・ 電極 D1 ・ D2 ・ ・ ・
・ ・ ・ 周囲 ・ ・ ・ ・ 交換膜 I1,I2 ・ 設 ・ ・
・ ・ ・ ・

・ ・ ・ ・ ・ 交換膜 I1,I2 ・ ・ ・ 電極 D1,D2
・ 周囲 ・ ・ 露光光 ・ 液体 LQ ・ 通過 ・ ・ 領域 ・
・ 区切 ・ ・ ・ ・

・ ・ ・ 電極 D1 ・ 周囲 ・ 雰囲気 ・ ・ ・ 交換
膜 I1 ・ 隔壁 K1 ・ ・ ・ 密閉空間 ・ ・ ・ ・
・ 密閉空間 ・ ・ 排気管 H1 ・ 接続 ・ ・ ・ ・
・ ・

・ ・ 電極 D2 ・ 周囲 ・ 雰囲気 ・ ・ ・ 交換膜
I2 ・ 隔壁 K2 ・ ・ ・ 密閉空間 ・ ・ ・ ・
・ 密閉空間 ・ ・ 排気管 H2 ・ 接続 ・ ・ ・ ・

・ ・ ・ 排気管 H1 ・ H2 ・ ・ ・ ・ 混合器 K ・
接続 ・ ・ ・ ・

・ ・ 混合器 K ・ ・ 電磁弁 DV ・ 備 ・ ・ 導入管
LD ・ 一端 ・ 接続 ・ ・ ・ ・ 導入管 LD ・
他端 ・ ・ 工 ・ ・ ・ ・ WT ・ 近傍 ・ 位置 ・ ・
・ ・ ・

0025 ・

電極 D1,D2 ・ ・ 印可電圧 ・ 図示 ・ ・ 電源供給
部 ・ ・ 供給 ・ ・ 電源供給部 ・ 供給 ・ ・ 印可
電圧 ・ ・ 第 2 制御部 CPU2 ・ ・ 制御 ・ ・ ・ ・

・ ・ 電磁弁 DV ・ 開閉 ・ 関 ・ ・ ・ ・ 第 2 制御
部 CPU2 ・ 制御 ・ ・ ・

本例 ・ ・ ・ ・ ・ 電極 D1,D2 ・ ・ ・ 交換膜
I1,I2 ・ 隔壁 K1,K2 ・ 排気管 H1,H2 ・ 混合器 K ・
電磁弁 DV ・ 導入管 LD ・ 図示 ・ ・ 電源供給部 ・
第 2 制御部 CPU2 ・ 屈折率調整手段 ・ 構成 ・
・ ・ ・

0026 ・

以下 ・ 屈折率調整手段 ・ 動作 ・ ・ ・ ・ 説明 ・
・ ・

以下 ・ 説明 ・ ・ ・ ・ ・ 液体 LQ ・ ・ 純水 ・ 添加
剤 ・ ・ ・ 塩化水素 ・ 加 ・ ・ ・ ・ ・

In this Figure 2, in order for liquid LQ not to permeate, it has stuck most optical member of wafer W side of projection optical system T, or and between gold frame of projection optical system T, packing is done.

In addition, aperture of plural is provided in base of the wafer table WT, wafer W is adsorbed into wafer table WT by vacuum doing from pipe V which is connected to these aperture.

And, electrode D1,D2 is provided in wafer table WT, ion exchange membrane I1,I2 is provided in the respective periphery of these electrode D1, D2.

With these ion exchange membrane I1,I2, region where periphery and exposure light of electrode D1,D2 pass liquid LQ is divided.

Here, atmosphere of periphery of electrode D1 has become sealed space depending upon with ion exchange membrane I1 and barrier K1, exhaust pipe H1 is connected to this sealed space.

In addition, atmosphere of periphery of electrode D2 has become sealed space depending upon with ion exchange membrane I2 and barrier K2, exhaust pipe H2 is connected to this sealed space.

These exhaust pipe H1, H2 are connected to mixer K together.

one end of inlet tube LD which has electric solenoid DV is connected by this mixer K, as for other end of this inlet tube LD, is a position of vicinity of the wafer table WT.

[0025]

Illustration there is not a applied voltage to electrode D1,D2 from power supply section to be supplied, applied voltage which power supply section supplies is controlled by 2 nd controller CPU 2.

In addition, in regard to opening and closing electric solenoid DV, 2 nd controller CPU 2 control.

With this example, these electrode D1,D2, ion exchange membrane I1,I2, barrier K1,K2, exhaust pipe H1,H2, mixer K, electric solenoid DV, inlet tube LD, illustrations are not power supply section, 2 nd controller CPU 2 configuration have done index of refraction adjustment means.

[0026]

You explain below, concerning operation of index of refraction adjustment means.

At time of explaining below, liquid LQ have assumed that it is something which adds hydrogen chloride to pure water as

..

.. 液体 LQ · 屈折率 · 下 · 場合 · 第 2 制御部 CPU2 · 電源供給部 · 指令 · 送 · 電極 D1 及 · 電極 D2 · 間 · 所定 · 電圧 · 所定 · 時間 · 加印 · ..

..... 陽極 電極 酸素気体 · 発生 · 陰極 電極 水素 · 塩素 混合気体 · 発生 · ..

..... 液体 LQ 塩化水素濃度 · 下 上記(1)式 液体 LQ · 屈折率 · 低下 · ..

..... 各 電極 D1,D2 · 近傍 · 発生 · 気体 交換膜 I1,I2 · 通過 排気管 H1,H2 · 介 · 回収 可能 · ..

.. 回収 気体 · 混合器 K · 送 混合器 K 回収 気体(酸素気体 · 水素気体 · 塩化水素気体) · 混 · 合 液体 LQ 高濃度 · 添加物水溶液 · 生成 · ..

0027 ·

.. 液体 LQ · 屈折率 · 上 · 場合 · 第 2 制御部 CPU2 · 電磁弁 DV · 開 · 高濃度 · 添加物水溶液 · 液体 LQ · 加 電磁弁 DV · 指令 · 送 · ..

..... 液体 LQ · 屈折率 · 上昇 · ..

.. 構成 液体 LQ · 屈折率 · 可変 · ..

.. 第 2 制御部 CPU2 · 接続 M1 種 照明条件 対応 屈折率 · 値 形 · 記憶 · ..

..... 屈折率 · 値 照明条件下 投影光学系 T · 生 · 収差 · 補正 必要 · 液体 LQ · 屈折率 · 値 · ..

..... M1 時点 液体 LQ 中 · 添加物濃度 · 値 · 常 · 更新 形 · 保管 · ..

0028 ·

.. 上記 · 照明光学系 IL 照明光学系 IL · 形成 · 面光源 · 形状 · 関 情報 · 第 2 制御部 CPU2 · 伝達 第 2 制御部 CPU2 · 接続 · ..

additive .

First, when index of refraction of liquid LQ is reduced, 2 nd controller CPU 2 send order to power supply section, just predetermined time adding sign does predetermined voltage between electrode D1 and electrode D2.

This time, oxygen vapor occurs from electrode which becomes the anode , mixed gas of hydrogen and chlorine occurs from electrode which becomes cathode .

~~This time, because hydrogen chloride density in liquid LQ goes down, as understood even from above-mentioned Formula (1), index of refraction of the liquid LQ decreases.~~

Here, as for vapor which occurs with vicinity of each electrode D1,D2,because ion exchange membrane I1,I2 is not passed, through exhaust pipe H1,H2, recovers is possible .

This vapor which recovers is sent to mixer K.

With mixer K, it can mix vapor (oxygen vapor, hydrogen vapor and hydrogen chloride vapor) which recovers, additive aqueous solution of high concentration is formed from this, in comparison with liquid LQ.

[0027]

~~In addition, when index of refraction of liquid LQ is increased, 2 nd controller CPU 2, opening electric solenoid DV, in order to add additive aqueous solution of high concentration to liquid LQ, send order to electric solenoid DV .~~

~~Because of this, index of refraction of liquid LQ rises .~~

With this configuration , index of refraction of liquid LQ can be designated as variable .

Well, in memory M1 which is connected to 2 nd controller CPU 2, corresponding every various illumination condition , value of index of refraction is remembered in form of the table .

Here, value of index of refraction is value of index of refraction of liquid LQ which is necessary in order correction to do aberration which it occurs with projection optical system T in under a certain illumination condition .

In addition, in this memory M1, value of additive density in liquid LQ in ascertain time point , is kept in form which always is renewed.

[0028]

In addition, above-mentioned illuminating optical system IL, 2 nd controller CPU 2 is connected in order to transmit information regarding shape of planar light source which this illuminating optical system IL forms to 2 nd controller CPU

.....照明条件-本例.....面光源・形状・変化.....情報・第2制御部 CPU2・伝達.....

.....第2制御部 CPU2.....伝達.....照明条件・対応.....屈折率・値.....M1.....検索.....屈折率・実現.....添加物・濃度・上記(1)式.....計算.....

次・第2制御部 CPU2.....M1・保管.....現在・添加物濃度.....計算.....添加物濃度.....從.....現在・添加物濃度.....計算.....添加物濃度.....電極 D1,D2.....電磁弁 DV・制御.....

0029・

.....液体 LQ・屈折率・値.....液体 LQ・含.....投影光学系 T・収差・補正.....

[第2・実施・形態]第2・実施・形態.....第1・実施・形態.....添加物・工.....点・大・異.....

.....工.....感光性基板.....塗布.....工・W.....層・溶解.....投影光学系 T.....最.....工・W側・光学部材(液体 LQ・接.....光学部材)及.....光学部材・施.....光学.....影響・少.....利点.....

0030・

.....第2・実施・形態.....屈折率調整手段・構成・第1・実施・形態.....異.....

以下・図3・参照.....屈折率調整手段・構成.....説明.....

.....図3.....図2・示.....同・機能・有.....部材.....同・符号・付.....

第2・実施・形態.....工.....WT・示・図3.....第1・実施・形態.....異.....点・添加物・液体 LQ・供給.....添加物供給管 LS・純水・液体 LQ・供給.....純水供給管 WS・液体 LQ・工.....WT.....溢.....液体 LQ・排出.....排出管 L・有.....点.....

0031・

.....添加物供給管 LS・純水供給管 WS及・排出管 L.....添加物及・純水・供給量・調

2.

When here, with illumination condition -this example shape - of planar light source changes, this information is transmitted to 2 nd controller CPU 2.

This time, 2 nd controller CPU 2 search value of index of refraction which corresponds to illumination condition which was transmitted from memory M1, calculate density of additive in order to actualize that index of refraction from above-mentioned Formula (1).

Next 2 nd controller CPU 2 present additive density and additive density which were calculated following, in order to make additive density which present additive density was calculated, with to electrode D1,D2 which are kept in memory M1 or control electric solenoid DV.

[0029]

Because of this, as for value of index of refraction of liquid LQ, when including liquid LQ, aberration of projection optical system T becomes something which correction is done.

As for [second embodiment] second embodiment, point which designates additive in first embodiment as ethyl alcohol differs largely.

As for this ethyl alcohol, resist as photosensitive group sheet does not melt resist layer of wafer W which application is done, in projection optical system T most optical member of wafer W side (optical member which touches with liquid LQ) and there is a benefit whose influence to optics coating which is administered to this optical member is little.

[0030]

In addition, configuration of index of refraction adjustment means differs from those of first embodiment regarding second embodiment.

Below, referring to Figure 3, you explain concerning configuration of the index of refraction adjustment means.

Furthermore, as those which are shown in Figure 2 in Figure 3, in member which possesses same function is attached same code.

Those of first embodiment as for point which differs, in order for the additive supply pipe LS in order to supply additive to liquid LQ and pure water feed pipe line WS and the liquid LQ in order to supply pure water to liquid LQ not to overflow from wafer table WT, it is a point which possesses discharge tube L which discharges liquid LQ in Figure 3 showing wafer table WT with second embodiment.

[0031]

Here, electric solenoid DVLS, DVWS in order to adjust supply amount of additive and the pure water and electric

整 電磁弁 DVLS, DVWS 及 液体 LQ 排出量 調整 電磁弁 DVL 設 電磁弁 DVLS, DVWS, DVL 開閉 . . . 第 2 制御部 CPU2 . . . 制御

第 2 実施形態 屈折率調整時 動作 説明

0032 .

. . . 液体 LQ 屈折率 上 . . . 場合 第 2 制御部 CPU2 電磁弁 DVLS 制御 . . . 所定 量 . . . 添加物 液体 LQ 加

. 排出管 L . . . 液体 LQ 所定 量 . . . 排出

. . . 排出 . . . 液体 LQ 量 . . . 加 添加物 量 同 好

. 液体 LQ 中 添加物濃度 高 屈折率 上昇

0033 .

. . . 液体 LQ 屈折率 下 . . . 場合 第 2 制御部 CPU2 電磁弁 DVWS 制御 . . . 所定 量 . . . 純水 液体 LQ 加

. 排出管 L . . . 液体 LQ 所定 量 . . . 排出

. . . 排出 . . . 液体 LQ 量 . . . 加 純水 量 同 好

. 液体 LQ 中 添加物濃度 低 屈折率 低下

0034 .

. 加 添加物及 純水 量 排出 . . . 液体 LQ 量 . . . 第 2 制御部 CPU2 . . . 制御

. M1 内 照明条件 種類 対応 . . . 屈折率 値 記憶 . . . 点 . . . 時点 液体 LQ 添加物濃度 値 保管 . . . 点 . . . 上述 第 1 実施形態 同様 情報 基 投影光学系 T 収差 補正 . . . 屈折率 実現 添加物濃度 計算 . . . 点 第 1 実施形態 同様

0035 .

. 第 2 実施形態 第 2 制御部 CPU2 M1 保管 現在 添加物濃度 計算 添加物濃度

solenoid DVL in order to adjust effluent amount of liquid LQ are respectively provided in additive supply pipe LS, pure water feed pipe line WS and discharge tube L, opening and closing these electric solenoid DVLS, DVWS, DVL is controlled by 2 nd controller CPU 2.

You explain concerning operation at time of index of refraction adjustment in second embodiment .

[0032]

First, when index of refraction of liquid LQ is increased, 2 nd controller CPU 2 controlling electric solenoid DVLS, just predetermined amount add additive to liquid LQ.

This time, just predetermined amount discharges liquid LQ from discharge tube L.

This as for quantity of liquid LQ which is discharged, it is the same as quantity of additive which is added, it is desirable.

Because of this, additive density in liquid LQ increases, index of refraction rises.

[0033]

In addition, when index of refraction of liquid LQ is reduced, 2 nd controller CPU 2 controlling electric solenoid DVWS, just predetermined amount add pure water to liquid LQ.

This time, just predetermined amount discharges liquid LQ from discharge tube L.

This as for quantity of liquid LQ which is discharged, it is the same as quantity of pure water which is added, it is desirable.

Because of this, additive density in liquid LQ becomes low, index of refraction decreases.

[0034]

Here, quantity of additive and pure water which are added and the quantity of liquid LQ which is discharged are controlled by 2 nd controller CPU 2.

Furthermore, corresponding to types of illumination condition inside memory M1, as for point where value of additive density of liquid LQ in point and a certain time point where value of index of refraction is remembered is kept, being similar to above-mentioned first embodiment, on basis of these information, Also point which calculates additive density in order to actualize the index of refraction which correction it is possible aberration of the projection optical system T is similar to first embodiment.

[0035]

This way, 2 nd controller CPU 2 in second embodiment following with to present additive density which is kept in memory M1 and additive density which was calculated,

inorder to make additive density which present additive density was calculated,control opening and closing electric solenoid DVLS,DVWS,DVL.

Because of this, as for value of index of refraction of liquid LQ, when including liquid LQ, aberration of projection optical system T becomes something which correction is done.

[embodiment of 3rd] Next, referring to Figure 4 , you explain concerning embodiment of 3rd .

In embodiment of 3rd aligner differs from above-mentioned 1st and 2nd embodiment in point which has aberration measuring apparatus .

Furthermore, as example of above-mentioned Figure 1 ~Figure 3 same code on member which possesses same function it is attached in Figure 4 , XYZcoordinate system which is similar to Figure 1 is adopted.

[0036]

In Figure 4, light source S supplies exposure light of wavelength 248nm, exposure light from this light source S, after being arranged in cross section of specified shape by the beam forming optical system 11, incidence does in 1 st fly eye lens 12.

secondary light source which consists of light source image of plural is formed on injection side of 1 st fly eye lens 12.

Passing by relay lens 13 F,13R, incidence it does exposure light from this secondary light source , to 2 nd fly eye lens 15.

This relay lens system configuration is done from front group 13 F and rear group 13 R, vibrating mirror 14 in order to prevent the speckle on irradiated surface is arranged in group 13 F before these and between rear group 13 R.

[0037]

Well, in emitting plane side of 2 nd fly eye lens 15, image of secondary light source plural form is formed with 1 st fly eye lens, this becomes 3 rd light source.

variable aperture drawing 16 which can set aperture drawing of plural which has predetermined shape or predetermined size is arranged in location where these 3 rd light source are formed.

This variable aperture drawing 16, as shown in for example Figure 5, is something which provides 6 aperture drawing 16a~16e which patterning are done in turret condition on transparent substrate which the configuration is done with such as quartz.

Here, as for 2 aperture drawing 16a,16b which have round aperture , with drawing in order to modify the s_i value (number of openings of illuminating optical system for

帶形狀・持・2・開口紋・16c,16d・互・
・輪帶比・異・紋・

・殘・2・開口紋・16e,16f・4・
・偏心・開口・有・紋・

・可變開口紋・16・可變開口紋・驅動・
・17・複數・開口紋・16a~16f・
何・一・光路內・位置・驅動・

0038・

圖4・戻・可變開口紋・16・露光光
・系18・集光・
・19上・重疊的・照明・

・19・光学系20F,20R
・関・R・形成面・共役・
配置・19・開口形
狀・R上・照明領域・形状・決定・

・19・露光光・光学系・
前群20F・反射鏡M及・光学系・
後群20R・介・R上・所定・位置・
實質的・均一・照度分布・照明領域・形成・

0039・

・前述・第1及・第2・實施・形態・
・照明光学系・IL・實施・形態・示・
・整形光学系11~・光学系20F,20R・
適用・

・R・-RL上・載
置・-RL・
・LT上・圖中XY方向及・Z軸・
中心・回轉方向(θ 方向)・移動可能・

・-RL・移動鏡RIM・設
・干涉計RI・
・-RL・XY方向及・ θ 方向・位置・検出・

・-RL・-驅
動・RLD・XY方向及・ θ 方向・驅
動・

・干涉計RI・出力・第1
制御部CPU1・伝達・第1制御部CPU1
・-驅動・RLD・制御・
・構成・

0040・

number of openings of projection optical system), as for 2 aperture drawing 16c,16d which have wheel band shape, it is a drawing where wheel band ratio differs mutually.

And, remaining 2 aperture drawing 16e,16f eccentricity of 4 are drawing which possesses aperture which is done.

This variable aperture drawing 16 is driven in order for inside any one of aperture drawing 16a~16f of the plural to be a position inside light path depending upon variable aperture drawing drive unit 17.

[0038]

Returning to Figure 4, exposure light from variable aperture drawing 16 light collection being done by condenser lens system 18 illumination does on reticle blind 19 superimposition.

reticle blind 19 is arranged in pattern formation surface and conjugation of reticle R in regard to relay optical system 20F,20R, shape of illumination region on reticle R is decided by open shape of reticle blind 19.

exposure light from reticle blind 19, through front group 20 F, reflector M of the relay optical system and rear group 20 R of relay optical system, forms illumination region of the uniform illumination distribution substantially in specified position on reticle R.

[0039]

Furthermore, illuminating optical system IL in aforementioned 1st and 2nd embodiment can also apply beam fairing optical system 11~relay optical system 20F,20R which is shown in this embodiment.

Well, reticle R is mounted on reticle loader -RL, this reticle loader -RL on holder table LT has become movable in the diagram XY direction and rotational direction (θ direction) which designates Z-axis as center.

Portable mirror RIM is provided in this reticle loader -RL, reticle interferometer RI detects the position of XY direction and θ direction of reticle loader -RL.

In addition, reticle loader -RL is driven to XY direction and θ direction by reticle loader -drive unit RLD.

Here, output from reticle interferometer RI is transmitted to 1st controller CPU 1, 1st controller CPU 1 has become configuration which controls reticle loader -drive unit RLD.

[0040]

・ ・ ・ 図示 ・ ・ ・ ・ ・ 搬送路
 ・ 途中 ・ ・ ・ ・ ・ R ・ 設
 ・ 読 ・ ・ ・ ・ ・ BR ・ 設
 ・ ・ ・ ・ ・

・ ・ ・ ・ ・ BR ・ 読 ・ ・ ・ ・ ・
 ・ R ・ 種類 ・ 関 ・ 情報 ・ 第 2 制御部 CPU2
 ・ 伝達 ・ ・ ・ ・ ・

・ ・ ・ 第 2 制御部 CPU2 ・ 接続 ・ ・ ・ ・ ・
 ・ M1 ・ ・ ・ ・ ・ R ・ 種類 ・ ・ ・ 最適 照
 明条件 関 ・ 情報 ・ ・ ・ ・ ・ R ・ 種類 ・ ・ ・
 ・ 最適 液体 LQ ・ 屈折率 値 ・ 記憶 ・ ・ ・
 ・ ・ ・ ・ ・

0041 ・

・ ・ ・ ・ R ・ 下側 ・ ・ ・ 所定 縮小倍率 $| \beta |$ ・
 有 ・ 投影光学系 T ・ 設 ・ ・ ・ ・ ・ 投
 影光学系 T ・ 最 ・ ・ ・ 工 ・ 面側 光学部材 ・ ・ ・
 工 ・ W ・ ・ 間 ・ ・ ・ 液体 LQ ・ 介在 ・ ・ ・ ・ ・

投影光学系 T ・ ・ ・ ・ 液体 LQ ・ 介 ・ ・ ・ 工 ・
 面上 ・ ・ ・ ・ ・ R ・ 縮小像 形成 ・ ・ ・ ・ ・

・ 工 W ・ ・ ・ 工 ・ ・ ・ ・ WT ・ 吸着固定 ・
 ・ ・ ・ ・ ・ 工 ・ ・ ・ ・ WT ・ ・ ・ 工 ・ ・ ・
 ・ ・ ・ WT 自体 Z 軸方向 ・ ・ 移動 ・ ・ ・ ・ ・
 (Z 軸 対 ・ 傾 ・) 行 ・ ・ ・ ・ ・ Z ・ ・ ・ ・ ・
 工 ・ ・ ZD1,ZD2,ZD3 ・ 介 ・ ・ 定盤 対 ・ ・ ・
 XY 方向 移動可能 ・ 工 ・ ・ ・ ・ WTS ・ ・
 取 付 ・ ・ ・ ・ ・

・ ・ ・ 工 ・ ・ ・ ・ WTS ・ ・ ・ 工 ・ ・ ・ ・ 駆
 動 ・ ・ ・ ・ WD ・ ・ ・ 駆動 ・ ・ ・ ・ ・

・ ・ ・ 工 ・ ・ ・ ・ 側壁 鏡面加工 施 ・
 ・ ・ ・ ・ 部分 ・ 工 干涉計 WI 移動
 鏡 ・ ・ ・ ・ ・

・ ・ ・ ・ 工 ・ ・ ・ ・ 駆動 ・ ・ ・ ・ WD ・ 駆動
 ・ 上述 第 1 制御部 CPU1 制御 ・ ・ ・ 工 ・
 干涉計 WI ・ ・ ・ 出力 第 1 制御部 CPU1 ・
 伝達 ・ ・ ・ 構成 ・ ・ ・ ・ ・

0042 ・

・ ・ 投影光学系 T ・ ・ 投影光学系 T ・ ・ 工
 ・ W ・ ・ 間 Z 方向 距離 測定 ・ ・ ・ ・ ・
 ・ ・ ・ ・ ・ AF 設 ・ ・ ・ ・ ・

・ ・ ・ ・ ・ AF ・ 投影光学系 T ・ ・ ・
 ・ ・ 工 W 側 近 光学素子 介 ・ ・ 工
 ・ 面上 光 照射 ・ ・ ・ ・ 工 ・ 反射 ・ ・ ・
 光 上記光学素子 介 受光 ・ ・ ・ 受光位
 置 ・ ・ 投影光学系 T ・ 工 W ・ 間 Z
 方向 距離 測定 ・ ・ ・ ・ ・

In addition, illustration it is not on middle of feeding passage from reticle stocker, barcode reader BR in order to grasp barcode which is provided in reticle R is provided.

information regarding types of reticle R which this barcode reader BR grasps is transmitted to 2 nd controller CPU 2.

Here, in memory M1 which is connected to 2 nd controller CPU 2, value of index of refraction of optimum liquid LQ is remembered in every types of information and reticle R regarding optimum illumination condition in every types of reticle R.

[0041]

projection optical system T which possesses predetermined reduction draw ratio $| \beta |$ is provided in underside of reticle R, liquid LQ has lain between most in the optical member of wafer surface side of this projection optical system T and between wafer W.

projection optical system T, through this liquid LQ, forms reduced image of reticle R on the wafer surface.

wafer W adsorptive immobilization is done in wafer table WT, this wafer table WT through Zactuators ZD1,ZD2,ZD3 in order it moves to Z-axis direction of wafer table WT itself and (slope for Z-axis) tilt, in XY direction is installed in movable wafer stage WTS vis-a-vis fixed base.

This wafer stage WTS is driven by wafer stage drive unit WD.

In addition, as for sidewall of wafer table mirror surfacing is administered, this portion has become portable mirror of wafer interferometer WI.

Here, drive of wafer stage drive unit WD is controlled with above-mentioned 1 st controller CPU 1, output from wafer interferometer WI has become configuration which is transmitted to 1 st controller CPU 1.

[0042]

In addition, focus sensor AF in order to measure distance of Z direction between projection optical system T and wafer W is provided in projection optical system T.

As for this focus sensor AF, through optical element which is close to wafer W side in projection optical system T light is irradiated on wafer surface, light which at the same time is reflected with wafer is done through the above-mentioned optical element, incident light, it is something which distance of Z direction between projection optical system T and wafer W is measured due to the light receiving position.

..... AF 構成 例
 特開平 6-66543 号公報 開示

0043

第 3 実施形態 添加物保管部 LST 貯蔵 高濃度 添加物水溶液
 液体 LQ 供給 添加物供給管 LS
 純水保管部 WST 貯蔵 純水 液体 LQ 供給 純水供給管 WS 備
 添加物供給管 LS 及 純水供給管 WS
 添加物水溶液及 純水 供給量 調整
 電磁弁 DVLS,DVWS 設

工 WT 液体 LQ 工
 溢 液体 LQ 排出
 排出管 L 設 排
 出管 L 液体 LQ 排出量 調整
 電磁弁 設

電磁弁 DVLS,DVWS,DVL 開閉 ..
 上述 第 2 実施形態 同様 第 2 制御部 CPU2 制御

0044

工 WT 上 投影光学系
 収差 測定 収差測定部 AS 液
 体 LQ 添加物濃度 検出 添加物
 濃度検出部 DS 設

収差測定部 AS 例 特開平
 6-84757 号公報 開示 用

収差測定部 AS 及 添加物濃度検出部
 DS 出力 第 2 制御部 CPU2 伝達

添加物濃度検出部 DS 出力 第
 2 制御部 CPU2 介 M1 時点
 液体 LQ 添加物濃度 値 保管

0045

次 第 3 実施形態 動作 説明

図示
 R 取出 -RL 上 載置
 途中 BR
 R 設 読 取
 情報 第 2 制御部 CPU2 伝達

and wafer W is measured due to the light-receiving position .

configuration of this kind of focus sensor AF is disclosed in
 for example Japan Unexamined Patent Publication Hei
 6-66543 disclosure .

[0043]

Well, regarding embodiment of 3 rd , we to have pure water
 feed pipe line WS in order to supply additive supply pipe LS
 in order to supply additive aqueous solution of high
 concentration which is stored in additive preservation tube part
 LST to liquid LQ and pure water which is stored in pure water
 preservation tube part WST to liquid LQ, in the additive
 supply pipe LS and pure water feed pipe line WS, electric
 solenoid DVLS,DVWS in order to adjust supply amount of
 additive aqueous solution and pure water is provided.

In addition, in order for liquid LQ not to overflow from wafer
 table ,discharge tube L in order to discharge liquid LQ is
 provided in wafer table WT,electric solenoid in order to adjust
 effluent amount of liquid LQ is provided in this discharge tube
 L.

Opening and closing these electric solenoid
 DVLS,DVWS,DVL in same way as above-mentioned second
 embodiment , is controlled by 2 nd controller CPU 2.

[0044]

In addition, aberration measurement part AS in order to
 measure aberration of projection optical system and additive
 concentration detection section DS in order to detect additive
 density of liquid LQ are provided on wafer table WT.

Here, those which are disclosed in for example Japan
 Unexamined Patent Publication Hei 6-84757 disclosure as
 aberration measurement part AS, can be used.

Here, output from aberration measurement part AS and
 additive concentration detection section DS is transmitted to 2
 nd controller CPU 2.

In addition, as for output from additive concentration
 detection section DS, through 2 nd controller CPU 2, to
 memory M1 it is kept as value of additive density of liquid
 LQ in time point which is.

[0045]

Next, you explain concerning operation of embodiment of 3
 rd .

First, illustration there is not a reticle R being removed from
 reticle stocker ,on middle which is mounted on reticle loader
 -RL, barcode reader BR barcode which is provided in reticle R
 transmits information of reading , to 2 nd controller CPU 2.

第2制御部 CPU2 M1 . 記憶 . . .
 R . 種類 . 対応 . 照明条件 . 関
 . . 情報 . 読 . 出 情報 . 従 . . 可変
 開口絞 . 駆動 17 . 制御 . . 開口絞 .
 16a~16f 所定 光路内 . 位置 .

. . . 第2制御部 CPU2 M1 . 記憶
 液体 LQ . 屈折率 . 値 . 基
 . . 屈折率 . 実現 添加物 . 濃度 .
 上記(1)式 . 計算 . . .

. . 後 . 添加物濃度検出部 DS . . . 検出 . .
 M1 . 保管 現在 . 添加物
 濃度 . 計算 添加物濃度 . 従 . . 現
 在 . 添加物濃度 . 計算 . . . 添加物濃度 . .
 電磁弁 DVLS, DVWS, DVL . 開閉 .
 制御 . . .

0046 .

. 液体 LQ . 屈折率 . 値 . 液体 LQ
 . 含 投影光学系 T . 収差 . 補正 . .

. . 後 AF 工 . W .
 Z方向 . 位置及 検出 工 . W
 . 所要 . 位置 Z 工 .
 ZD1, ZD2, ZD3 . 駆動 . . .

. . 状態 光源 S . . . 露光光 . 照明
 光学系 . 介 R . 導 . 第1制御部
 CPU1 干涉計 RI 及 . . 工 . 干涉計
 WI R 及 . . 工 . W . 位置 . 検
 出 駆動 RLD 及
 . . 工 駆動 WD . 駆動 . . .
 R 及 . . 工 . W . 投影光学系 T . 投
 影倍率 $|\beta|$. 速度比 . 元 . 移動

. R 上 良好 .
 結像状態 工 . W 上 . 転写

0047 .

. . . 投影光学系 T . 結像性能(収差 . .) . .
 常 . 一定 温度変化 . 大気圧変化 . 投
 影光学系 T . 露光光 . 吸収 温度
 上昇 変化 . . 場合

. . . 第3 . 実施 . 形態 . . . 収差測定部 AS
 . . . 実際 . 投影光学系 T . 収差(結像性能)
 . 測定 測定結果 . 基 . . . 液体 LQ .
 屈折率 . 値 . 調整 . . 構成

0048 .

Following information regarding illumination condition which corresponds to types of reticle R which is remembered in memory M1 to information of the reading, controlling variable aperture drawing drive unit 17, predetermined one among aperture drawing 16a~16f location it does 2nd controller CPU 2, inside light path.

In addition, 2nd controller CPU 2 calculate density of additive in order to actualize that index of refraction on basis of value of index of refraction of liquid LQ which is remembered in memory M1, from the above-mentioned Formula (1).

After that, being detected by additive concentration detection section DS, following with to present additive density which is kept in memory M1 and additive density which was calculated, in order to make additive density which present additive density was calculated, it controls opening and closing electric solenoid DVLS, DVWS, DVL.

[0046]

Because of this, as for value of index of refraction of liquid LQ, when including liquid LQ, aberration of projection optical system T becomes something which correction is done.

Detecting location and tilt of Z direction of wafer W after this, with focus sensor AF, in order for wafer W to become the necessary location, it drives Z actuator ZD1, ZD2, ZD3.

In this state, through illuminating optical system, it leads exposure light from light source S to reticle R, while detecting location of reticle R and wafer W with reticle interferometer RI and wafer interferometer WI, driving reticle loader-drive unit RLD and wafer stage drive unit WD, reticle R and wafer W it moves 1st controller CPU 1, in origin of speed ratio of projection draw ratio $|\beta|$ of projection optical system T.

Because of this, pattern on reticle R is copied to on wafer W in origin of satisfactory imaging state.

[0047]

Well, imaging performance (Such as aberration) of projection optical system T is not fixed always, temperature change and atmospheric pressure change and there are times when it changes temperature rise etc with by fact that projection optical system T absorbs exposure light.

Then, it has made configuration which with embodiment of 3rd, measures aberration (imaging performance) of actual projection optical system T due to aberration measurement part AS, adjusts value of index of refraction of liquid LQ on basis of this measurement result.

[0048]

具体的・第3・実施・形態・
M1 内・投影光学系・収差値・対応・形
・収差・補正・液体 LQ・屈折率・
値・記憶・

・収差測定部 AS・検出・投影
光学系 T・収差・第2制御部 CPU2・伝達・

第2制御部 CPU2・M1 内・記憶・
・液体 LQ・屈折率・値・読・出・
屈折率・値・添加物濃度・上記(1)
式・求・液体 LQ・添加物濃度・
・電磁弁 DVLS,DVWS,DVL・開閉・制御・

0049・

・構成・投影光学系 T・環境変化(温
度変化・大気圧変動・露光光吸収・変動)
・結像性能・良好・維持・

・収差測定部 AS・測定・常時
行・必要・所定・周期・行・良・

[第4・実施・形態]次・図6・参照・第4
・実施・形態・説明・

第4・実施・形態・投影光学系・工・
間・光路・全・液体・満・構成・
・光路・一部・液体・満・構成・

0050・

図6(a), (b)・図1~3・示・第1及・
第2・実施・形態・同・機能・有・部材・
同・符号・伏・

図6(a), (b)・示・第4・実施・形態・工・
・WT・側壁・液体 LQ・溜・代
・露光光・透過・材料(例・石英・
・)・構成・容器 C1,C2 中・液体 LQ・満・
・構成・前述・第1及・第2・実施・形態・
・異・

・構成・前述・第1及・第2・実施・
形態・有・効果・開口数増大・
・実効の焦点深度拡大・効果・
連続的・投影光学系 T・収差(結像性能)調整
・可能・効果・有・

0051・

Concrete, with embodiment of 3rd, in form which corresponds to aberration value of projection optical system inside memory M1, value of index of refraction of liquid LQ which correction, it is possible aberration is remembered.

aberration of projection optical system T which is detected and, by aberration measurement part AS is transmitted to 2nd controller CPU 2.

In order value of index of refraction of liquid LQ which is remembered inside memory M1 to reach value of this index of refraction of the reading, additive density above-mentioned Formula (1) from it seeks 2nd controller CPU 2, in order for liquid LQ to become additive density, it controls opening and closing electric solenoid DVLS, DVWS, DVL.

[0049]

Depending upon this configuration, there being a environmental change (It fluctuates with temperature change, atmospheric pressure fluctuation and exposure light absorption) of projection optics T, it can maintain imaging performance satisfactorily.

Furthermore, measures with this aberration measurement part AS and does not have necessity usual to do in every predetermined cycle, it is good.

[embodiment of 4th] Referring to Figure 6 next, you explain concerning embodiment of 4th.

embodiment of 4th is not configuration which fills up all of the light path between projection optical system and wafer with liquid, is something which is made configuration which satisfies portion of this light path with liquid.

[0050]

Figure 6(a), in (b), as 1st and 2nd embodiment which is shown in Figure 1~3 the same code to member which possesses same function.

Figure 6(a), in embodiment of 4th which are shown in (b), the liquid LQ reservoir * in substituting, configuration which fills up liquid LQ in canister C1, C2 which configuration is done differs from aforementioned 1st and 2nd embodiment in material (Such as for example quartz) which transmits exposure light depending upon the sidewall of wafer holder -WT.

With this configuration, among effects which aforementioned 1st and 2nd embodiment has had, effect of number of openings increase or effective focus depth enlargement although it is not, has had effect to which aberration (imaging performance) adjustment of projection optical system T becomes possible in continuous.

[0051]

..... 第 4 ・ 実施 ・ 形態 液体 LQ
 ・ 入 容器 C1,C2 ・ 投影光学系 T ・
 一体 ・ 設 良

以上 ・ 第 1~第 4 ・ 実施 ・ 形態 液体 LQ ・
 ・ 純水 ・ 用 純水 ・ 限

0052 ・

・ 發明 ・ 效果 ・

以上 ・ 示 本發明 投影光学
 系 ・ 結像性能 ・ 振動 ・ 連續的 ・ 調整

..... 開口数 ・ 增大(或 実効的 ・ 焦点深度
 ・ 拡大) ・ 結像性能 ・ 調整 両立
 可能

・ 図面 ・ 簡単 ・ 説明 ・

図 ..

本發明 ・ 第 1 及 ・ 第 2 ・ 実施 ・ 形態
 露光装置 ・ 全体の ・ 示 ・ 概略図

図 ..

本發明 ・ 第 1 ・ 実施 ・ 形態 露光装置
 ・ 要部 ・ 示 ・ 断面図

図 ..

本發明 ・ 第 2 ・ 実施 ・ 形態 露光装置
 ・ 要部 ・ 示 ・ 断面図

図 ..

本發明 ・ 第 3 ・ 実施 ・ 形態 露光装置
 ・ 示 ・ 概略図

図 ..

本發明 ・ 第 3 ・ 実施 ・ 形態 露光装置
 ・ 一部 ・ 示 ・ 概略図

図 ..

本發明 ・ 第 4 ・ 実施 ・ 形態 露光装置
 ・ 要部 ・ 示 ・ 断面図

・ 符号 ・ 説明 ・

D1

電極

D2

電極

H1

Furthermore, projection optics T it is good providing vessel C1,C2 where liquid LQ is inserted in embodiment of these 4 th , as one unit.

With embodiment of 1 st ~4th above, pure water was used as liquid LQ, but there are not times when it is limited to pure water .

[0052]

[Effects of the Invention]

As shown above, adjustment can be designated as continuous according to this invention , imaging performance of projection optical system without vibration.

In addition, increase of number of openings (Or enlargement of effective focus depth) with you adjust imaging performance the both achievements , it becomes possible.

[Brief Explanation of the Drawing(s)]

[Figure 1]

It is a conceptual diagram which shows aligner which depends on 1 st and 2nd embodiment of the this invention in entire .

[Figure 2]

It is a sectional view which shows principal part of aligner which depends on first embodiment of this invention .

[Figure 3]

It is a sectional view which shows principal part of aligner which depends on second embodiment of this invention .

[Figure 4]

It is a conceptual diagram which shows aligner which depends on embodiment of 3 rd of this invention .

[Figure 5]

It is a conceptual diagram which shows portion of aligner which depends on embodiment of 3 rd of this invention .

[Figure 6]

It is a sectional view which shows principal part of aligner which depends on embodiment of 4 th of this invention .

[Explanation of Symbols in Drawings]

D1

electrode

D2

electrode

H1

JP1998340846A

1998-12-22

配管

pipe

H2

H2

配管

pipe

I1

I1

・・・交換膜

ion exchange membrane

I2

I2

・・・交換膜

ion exchange membrane

IL

IL

照明光学系

illuminating optical system

K1

K1

隔壁

barrier

K2

K2

隔壁

barrier

L

L

排出管

discharge tube

LD

LD

導入管

inlet tube

LQ

LQ

液体

liquid

LS

LS

添加物供給管

additive supply pipe

LT

LT

.....

[roodaateeburu]

M

M

反射板

deflector

M1

M1

.....

memory

R

R

.....

reticle

RL

RL

.....

[rechikururoodaa]

S

S

光源

light source

SS

SS

.....

sensor

T
投影光学系

T1
駆動装置

T2
駆動装置

V
減圧管

W
・工

WS
純水供給管

WT
・工

Drawings

図 . .

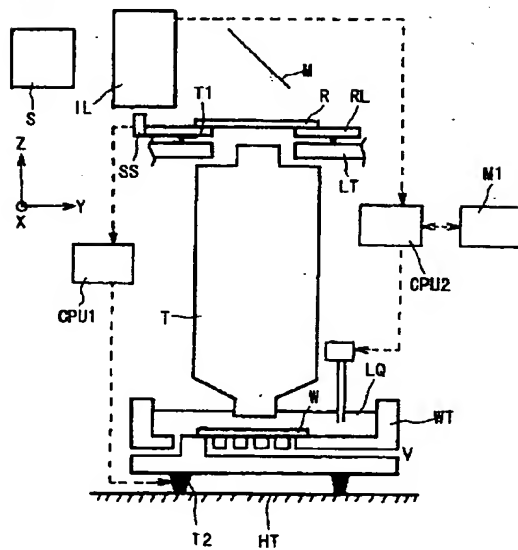


図 . .

T
projection optical system

T1
drive device

T2
drive device

V
vacuum tube

W
wafer

WS
pure water feed pipe line

WT
wafer table

[Figure 1]

[Figure 2]

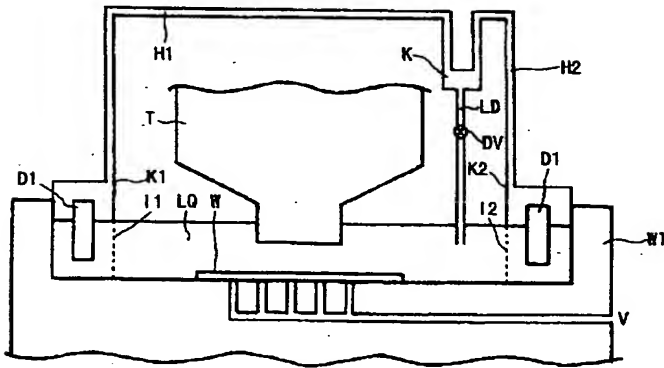


図 ・・

[Figure 3]

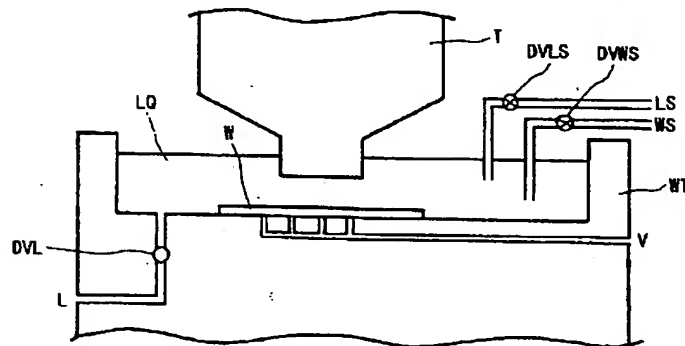
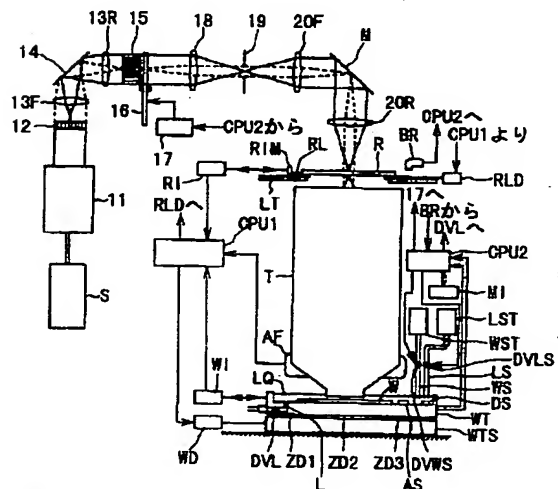


図 ・・

[Figure 4]

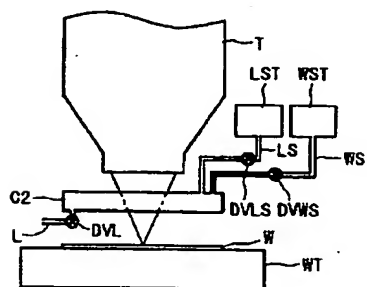
図 ・・

[Figure 5]





[Figure 6]



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